

Attorney Docket No.: 02SPE130P

REMARKS

Prior to the present response, claims 1-8 and 21-30 were pending in the present application. Claims 1-8 and 21-30 remain in the present application. Reconsideration and allowance of pending claims 1-8 and 21-30 in view of the following remarks are requested.

A. Rejection of Claims 1-8 and 29-30 under 35 USC §102(e)

The Examiner has rejected claims 1-8 and 29-30 under 35 USC §102(e) as being anticipated by U.S. patent number 6,184,121 B1 to Buchwalter et al. (hereinafter "Buchwalter"). For the reasons discussed below, Applicants respectfully submits that the present invention, as defined by independent claims 1 and 29, is patentably distinguishable over Buchwalter.

The present invention, as defined by independent claim 1, recites, among other things, forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer. As disclosed in the present application, a first dielectric layer and a first capping layer are sequentially deposited over a substrate and trenches are etched in the first dielectric layer and the first capping layer. The first dielectric layer can comprise, for example, a low dielectric constant (low-k) material and the first capping

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layer can comprise, for example, silicon nitride. As disclosed in the present application, metal lines are formed by filling the trenches with a metal such as copper or aluminum.

As disclosed in one embodiment in the present application, air gaps (i.e. air trenches) are formed in the first dielectric layer between selected metal lines. By forming air gaps in the first dielectric layer between selected metal lines, parasitic capacitance (i.e. intra-layer capacitance) between metal lines that are situated within the same metal layer (i.e. intra-layer capacitance) is advantageously reduced. As disclosed in the present application, a second capping layer and a second dielectric layer can be sequentially formed over the first capping layer and, in one embodiment, air gaps can be formed that extend through the second dielectric layer and the first dielectric layer. By extending the air gaps through the second dielectric layer and the first dielectric layer, parasitic capacitance between metal lines in adjacent metal layers (i.e. inter-layer capacitance) is advantageously reduced. Thus, the present invention advantageously achieves an improved damascene interconnect structure that advantageously reduces intra-layer and inter-layer capacitance.

In contrast to the present invention as defined by independent claim 1, Buchwalter does not teach, disclose, or suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer. Buchwalter specifically discloses forming dielectric layers 20 and 30 over substrate 10 and etching trenches 50 in dielectric layer 30

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(i.e. the top dielectric layer) and vias 40 in dielectric layer 20 (i.e. the bottom dielectric layer). See, for example, column 2, lines 1-4 and Figure 2A of Buchwalter. In Buchwalter, trenches 50 are formed for wiring tracks (i.e. metal lines) and vias 40 are formed to connect the wiring tracks to a lower metal level. See, for example, column 2, lines 3-6 and Figure 2A of Buchwalter.

In Buchwalter, electrically conductive barrier/adhesion layer 60 and copper-based conductive layer 70 are sequentially deposited in trenches 50 and vias 40 so as to fill trenches 50 and vias 40 with metal, and a chemical-mechanical polishing (CMP) process is used to planarize the top surface by removing excess copper and barrier layer material. See, for example, column 2, lines 9-19 and Figures 2B and 2C of Buchwalter. Thus, in Buchwalter, wiring tracks (i.e. metal lines) are formed in a metal level by filling trenches 50, which are formed in dielectric layer 30, with metal and vias 40, which are formed in dielectric layer 20, are filled with metal to connect the wiring tracks (i.e. metal lines) to a lower metal level. Thus, in Buchwalter, the wiring tracks (i.e. metal lines) are situated only in dielectric layer 30, not in dielectric layer 20.

In contrast, independent claim 1 specifies forming a plurality of spaced-apart metal lines by forming a plurality of trenches in a first capping layer and a first dielectric layer and filling the plurality of trenches with metal. Consequently, as specified in independent claim 1, the spaced-apart metal lines are situated in both first dielectric layer and the first capping layer. Thus, the damascene interconnect structure specified in independent claim 1 is significantly different than the interconnect structure disclosed in Buchwalter. Thus,

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Buchwalter fails to teach, disclose, or suggest forming a plurality of trenches in a first capping layer and a first dielectric layer and filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer, as specified in amended independent claim 1.

For the foregoing reasons, Applicants respectfully submit that the present invention, as defined by independent claim 1, is not taught, disclosed, or suggested by Buchwalter. Thus, independent claim 1 is patentably distinguishable over Buchwalter. As such, claims 2-8 depending from independent claim 1 are, *a fortiori*, also patentably distinguishable over Buchwalter for at least the reasons presented above and also for additional limitations contained in each dependent claim.

Independent claim 29 includes similar limitations as independent claim 1. Thus, for the reasons discussed above, Applicant respectfully submits that the present invention, as defined by independent claim 29, is not suggested, disclosed, or taught by Buchwalter. Thus claim 30 depending from independent claim 29 is, *a fortiori*, also patentably distinguishable over Buchwalter for at least the reasons presented above and also for additional limitations contained in the dependent claim.

B. Rejection of Claims 21-28 under 35 USC §103(a)

The Examiner has rejected claims 21-28 under 35 USC §103(a) as being unpatentable over Buchwalter in view of U.S. patent number 5,708,303 to Shin-Puu Jeng

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(hereinafter "Jeng"). For the reasons discussed below, Applicants respectfully submits that the present invention, as defined by independent claim 21, is patentably distinguishable over Buchwalter and Jeng, singly or in combination thereof.

The present invention, as defined by independent claim 21, recites, among other things, forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer. The present invention, as defined by independent claim 21, provides similar advantages as the present invention as defined by amended independent claim 1 as discussed above.

As discussed above, Buchwalter fails to teach, disclose, or suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer.

In contrast to the present invention as defined by independent claim 21, Jeng does not teach, disclose, or suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer. The Examiner has cited Jeng to disclose

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that it is well known in the art to deposit an etch stop layer directly on a polish stop layer.

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However, Jeng fails to teach, disclose, or remotely suggest forming a plurality of trenches in a first capping layer and a first dielectric layer, filling the plurality of trenches with metal to form a plurality of spaced-apart metal lines, where the plurality of spaced-apart metal lines are situated in the first capping layer and the first dielectric layer, as specified in independent claim 21. Thus, Jeng fails to cure the basic deficiencies of Buchwalter discussed above. Thus, Applicants respectfully submit that the combination of Buchwalter and Jeng does not and cannot result in the claimed invention.

For the foregoing reasons, Applicants respectfully submit that the present invention, as defined by independent claim 21, is not taught, disclosed, or suggested by Buchwalter and Jeng, singly or in combination thereof. Thus, independent claim 21 is patentably distinguishable over Buchwalter and Jeng. As such, claims 22-28 depending from independent claim 21 are, *a fortiori*, also patentably distinguishable over Buchwalter and Jeng for at least the reasons presented above and also for additional limitations contained in each dependent claim.

C. Conclusion

Based on the foregoing reasons, the present invention, as defined by independent claims 1, 21, and 29, and claims depending therefrom, is patentably distinguishable over the art cited by the Examiner. Thus, claims 1-8 and 21-30 pending in the present

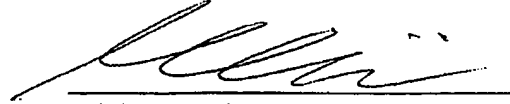
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application are patentably distinguishable over the art cited by the Examiner. As such, and for all the foregoing reasons, an early allowance of claims 1-8 and 21-30 pending in the present application is respectfully requested.

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Respectfully Submitted,
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